Johnson

electronic equipment

OPERATING MANUAL

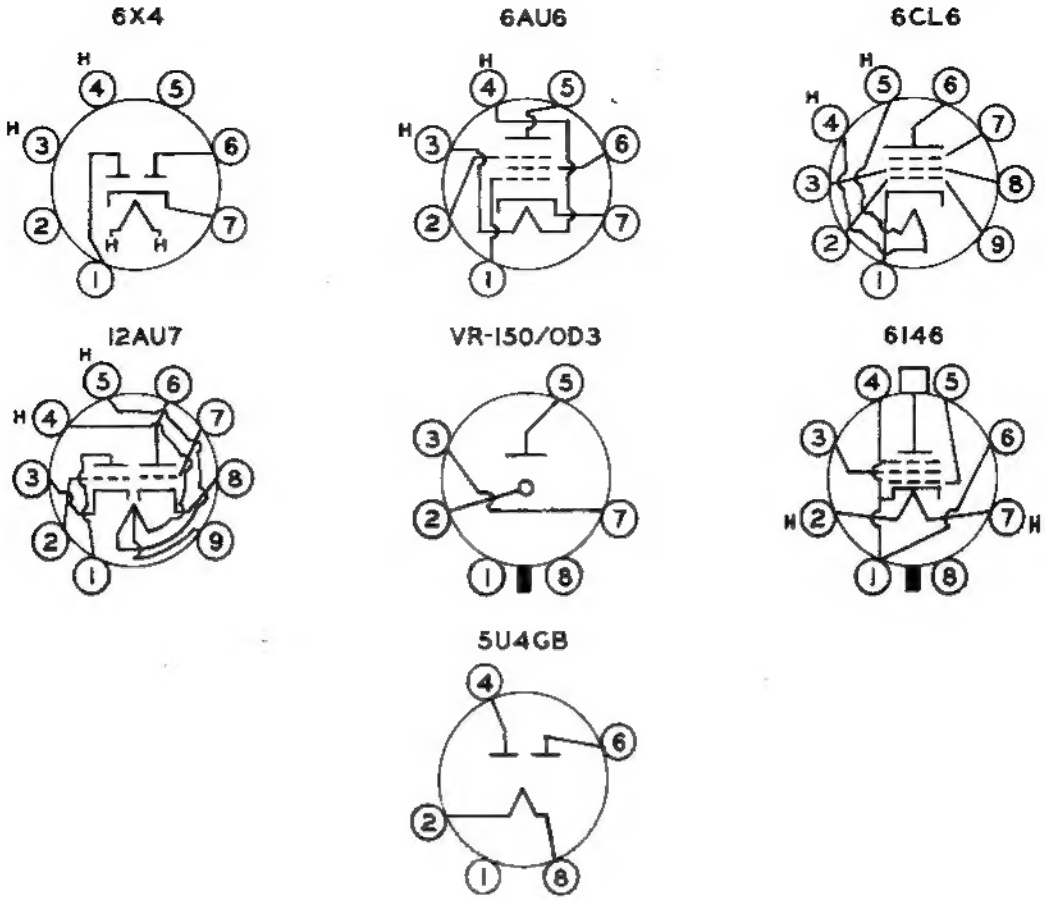
VIKING NAVIGATOR

EXCITER/TRANSMITTER

E. F. Johnson Company

WASECA, MINNESOTA

TUBE SOCKET CONNECTIONS BOTTOM VIEW



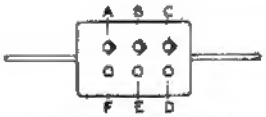
CONDENSER-RESISTOR COLOR CODE

COLOR	SIGNIFICANT FIGURE	DECIMAL MULTIPLIER	TOLERANCE (%)	VOLTAGE RATING*
BLACK	0	1	—	—
BROWN	1	10	1	100
RED	2	100	2	200
ORANGE	3	1,000	3	300
YELLOW	4	10,000	4	400
GREEN	5	100,000	5	500
BLUE	6	1,000,000	6	600
VIOLET	7	10,000,000	7	700
GRAY	8	100,000,000	8	800
WHITE	9	1,000,000,000	9	900
GOLD	-	0.1	5	1,000
SILVER	-	0.01	10	2,000
NO COLOR	-	—	20	500

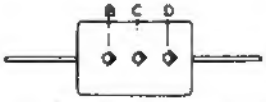
* APPLIES TO CONDENSERS ONLY

COLOR CODING OF FIXED RESISTORS

A-FIRST SIGNIFICANT FIGURE OF RESISTANCE IN OHMS
B-SECOND SIGNIFICANT FIGURE
C-DECIMAL MULTIPLIER
D-RESISTANCE TOLERANCE IN PERCENT IF NO COLOR SHOWN TOLERANCE IS ± 20%



JAN FIXED CAPACITORS



RMA 3-DOT CODE 500VOLT ± 20%

COLOR CODING OF FIXED CONDENSERS
A-TYPE MICA BLACK, PAPER SILVER
B-FIRST SIGNIFICANT FIGURE OF CAPACITY
C-SECOND SIGNIFICANT FIGURE
D-DECIMAL MULTIPLIER
E-TOLERANCE
F-CHARACTERISTIC
G-THIRD SIGNIFICANT FIGURE
H-VOLTAGE RATING

RMA 6-DOT CODE

Figure AA

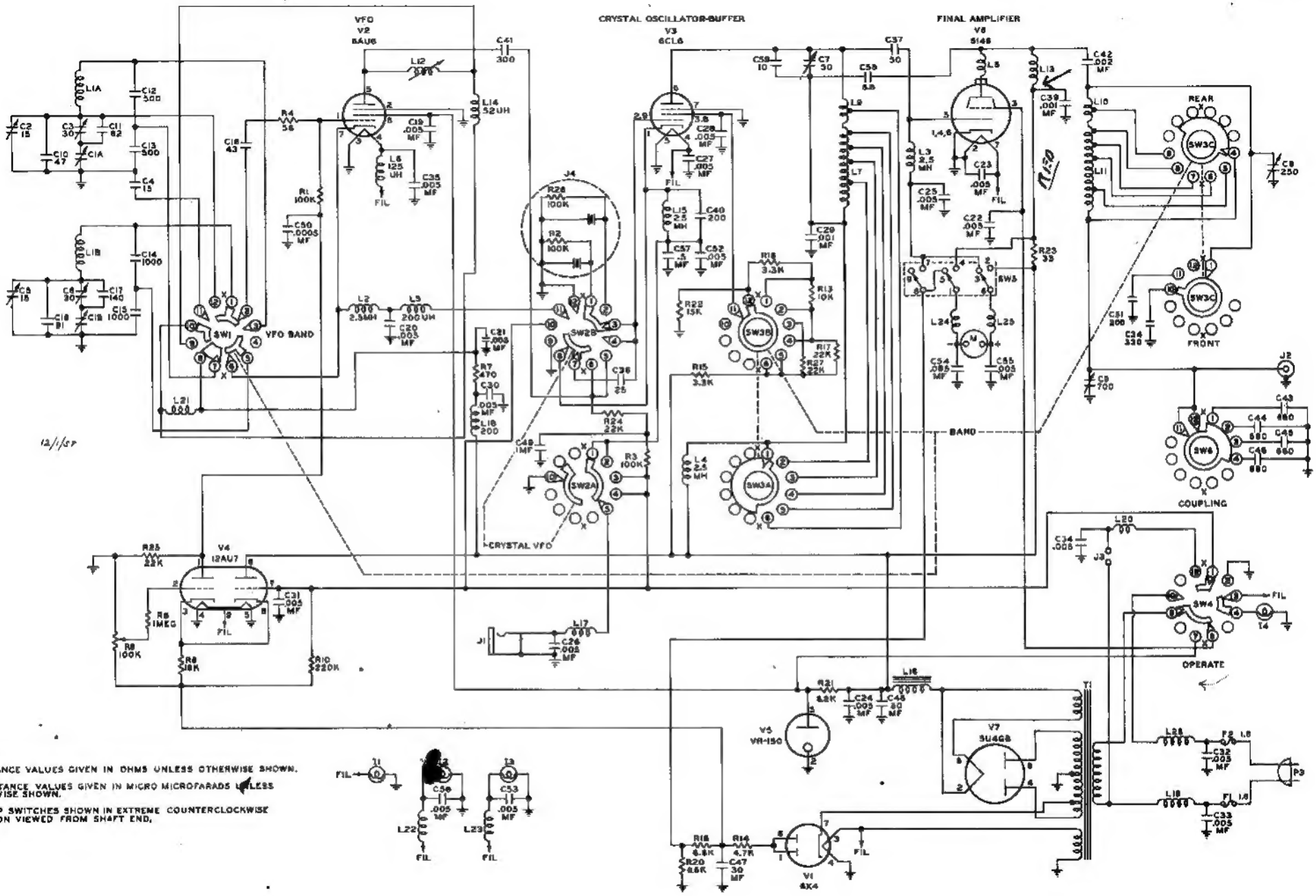

VFO
V2
6AU6
CRYSTAL OSCILLATOR-BUFFER
V3
6CL6
FINAL AMPLIFIER
V8
5148
REAR
FRONT
VFO BAND
BAND
COUPLING
OPERATE
CRYSTAL VFO
V4
12AU7
V5
VR-150
V7
5U4GB
V1
4X4
RESISTANCE VALUES GIVEN IN OHMS UNLESS OTHERWISE SHOWN.
CAPACITANCE VALUES GIVEN IN MICRO MICROFARADS UNLESS OTHERWISE SHOWN.
ALL TAP SWITCHES SHOWN IN EXTREME COUNTERCLOCKWISE POSITION VIEWED FROM SHAFT END.

Figure AD

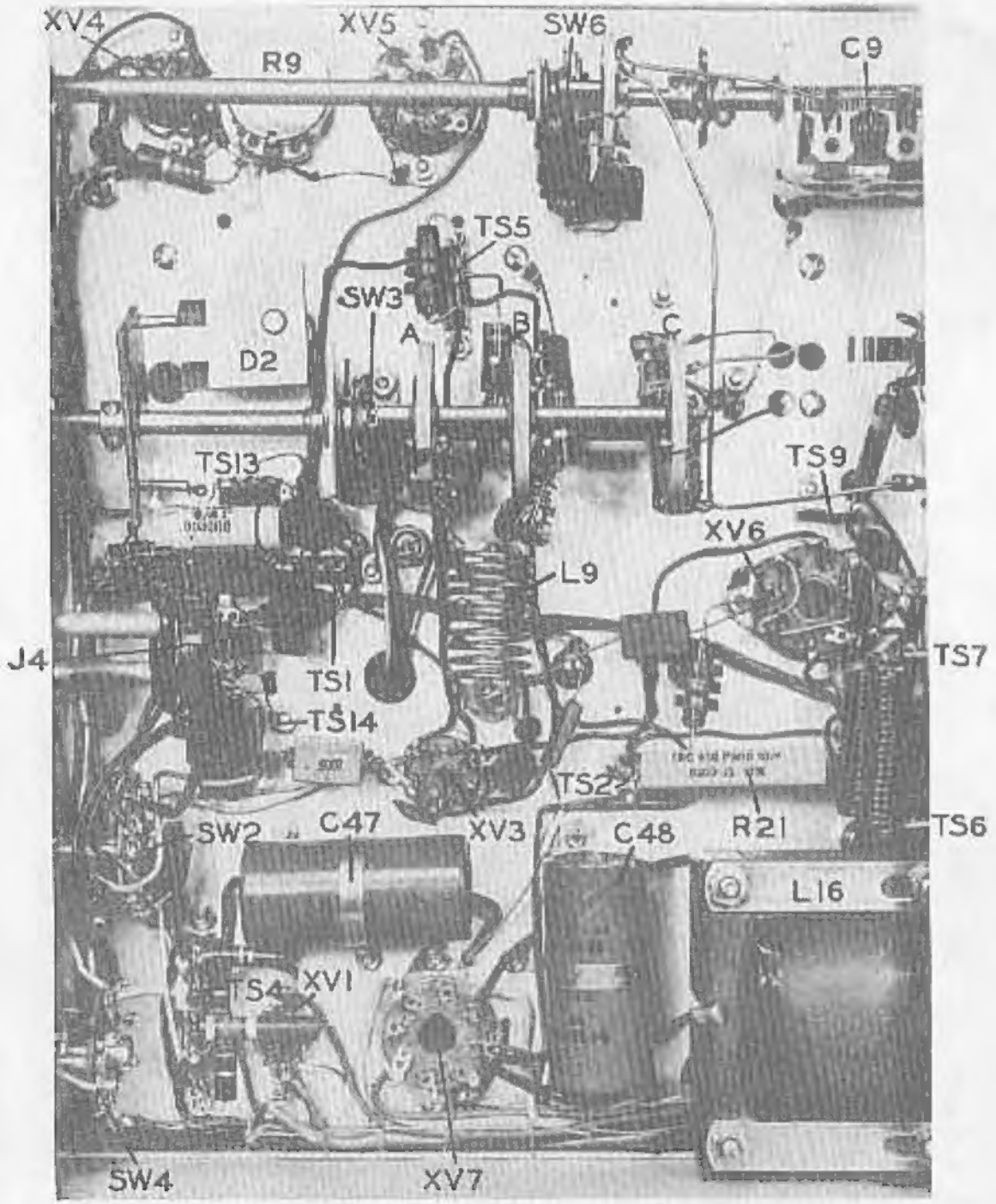


Figure S

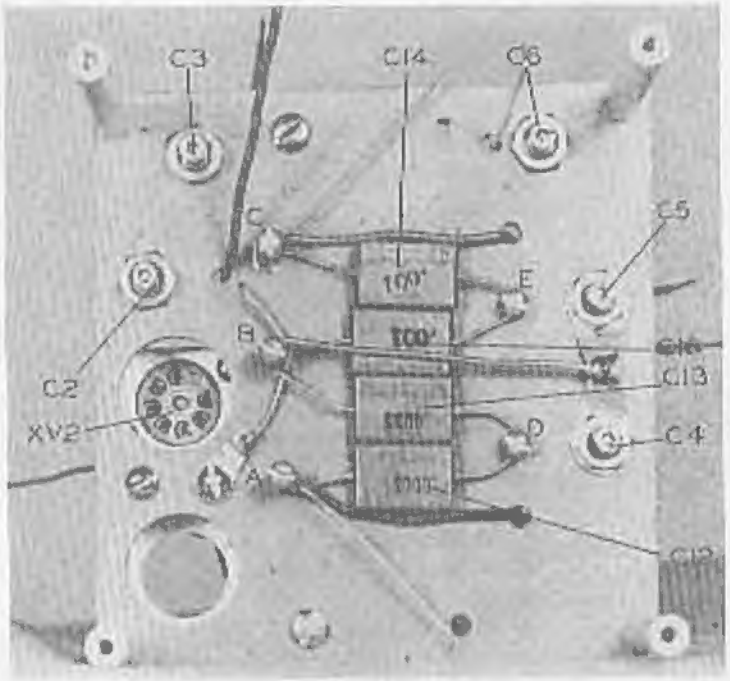


Figure T

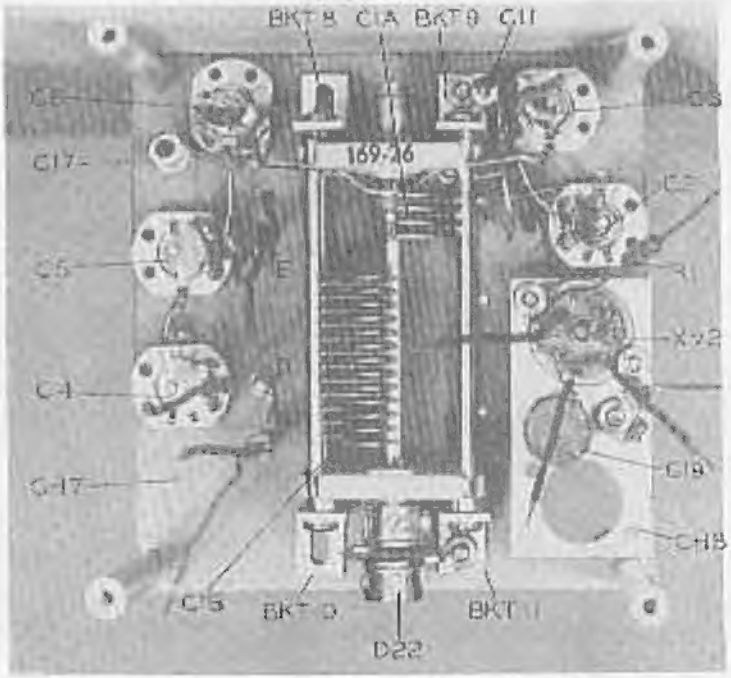


Figure U

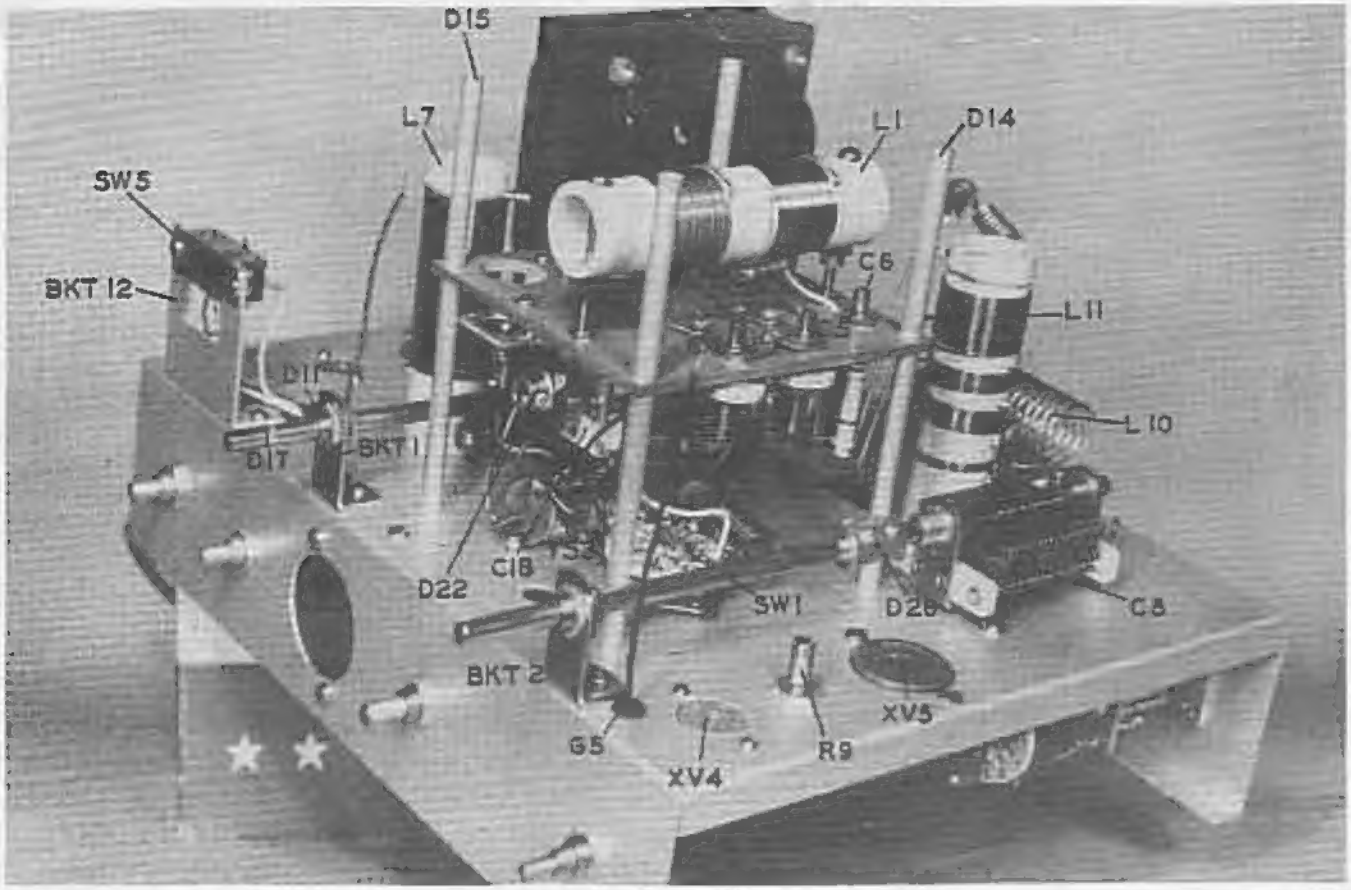


Figure V

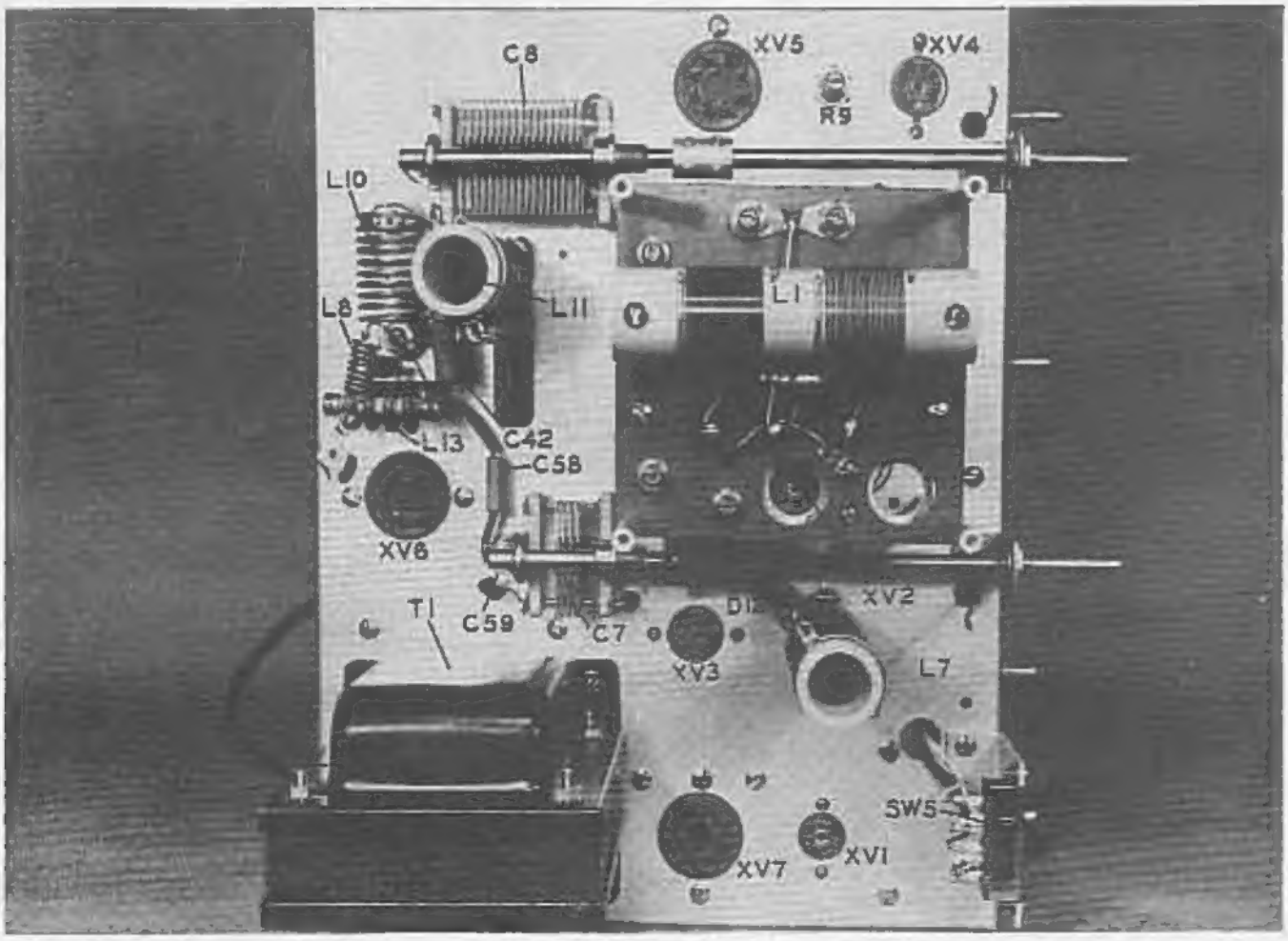


Figure W

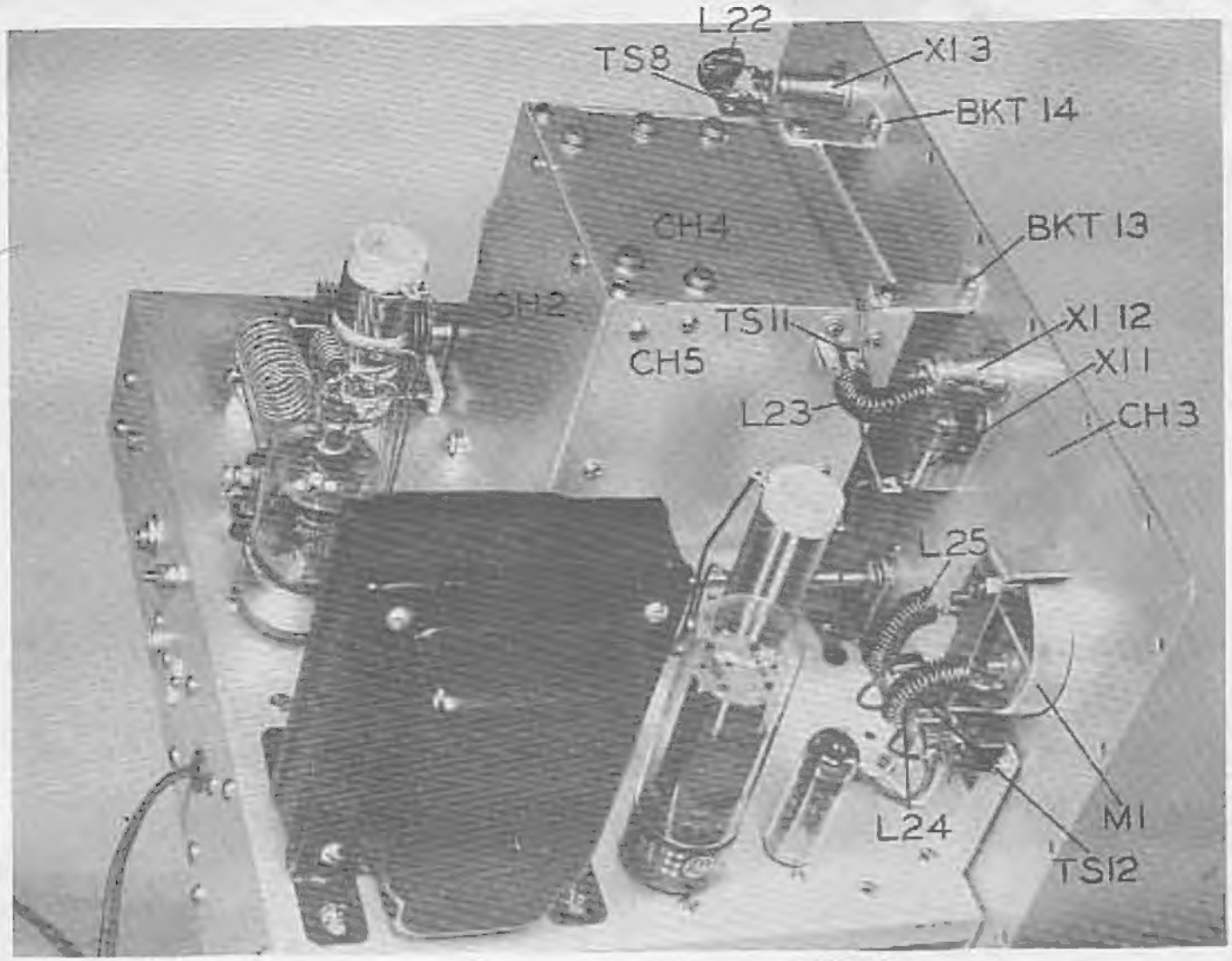


Figure X

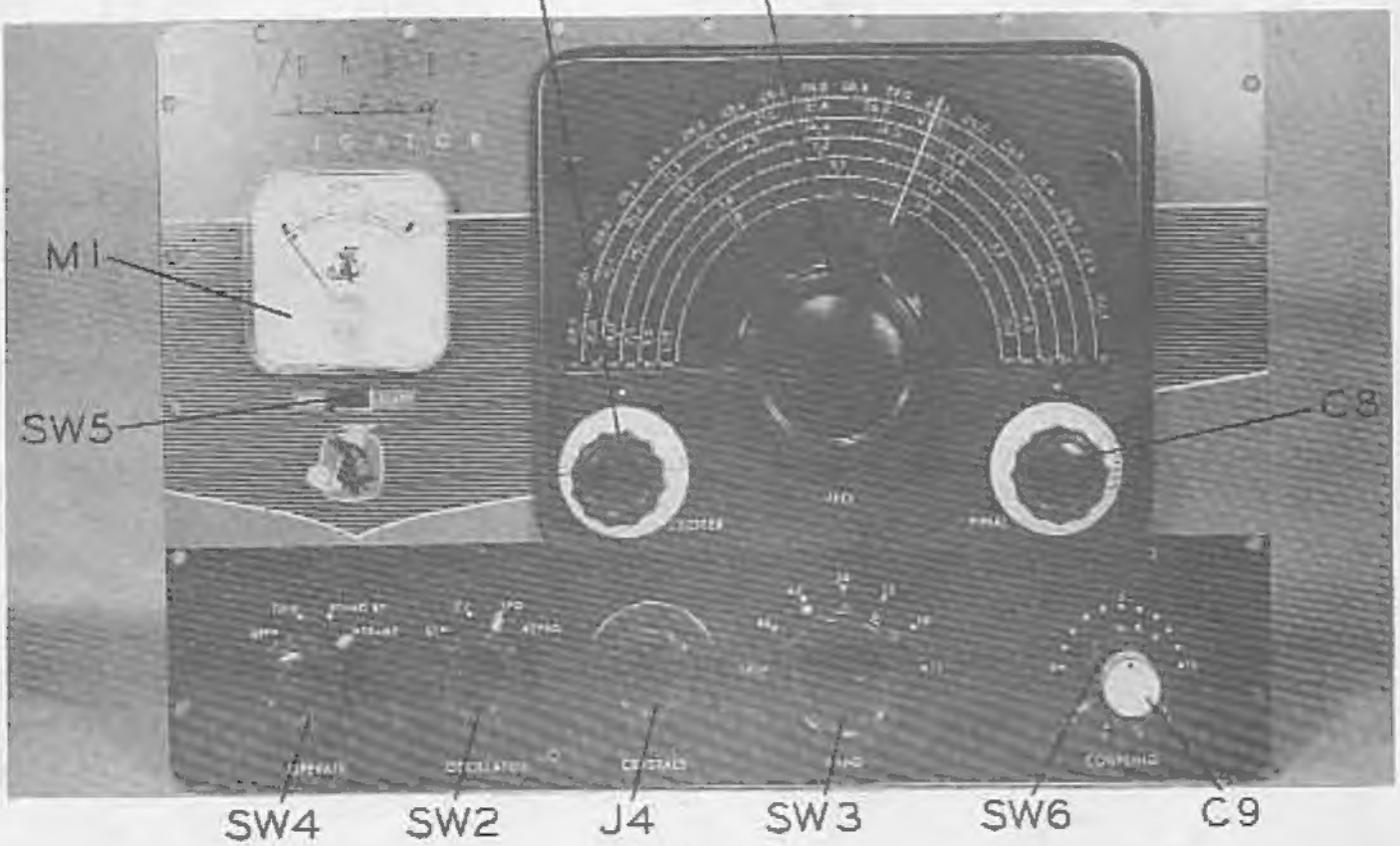


Figure Y

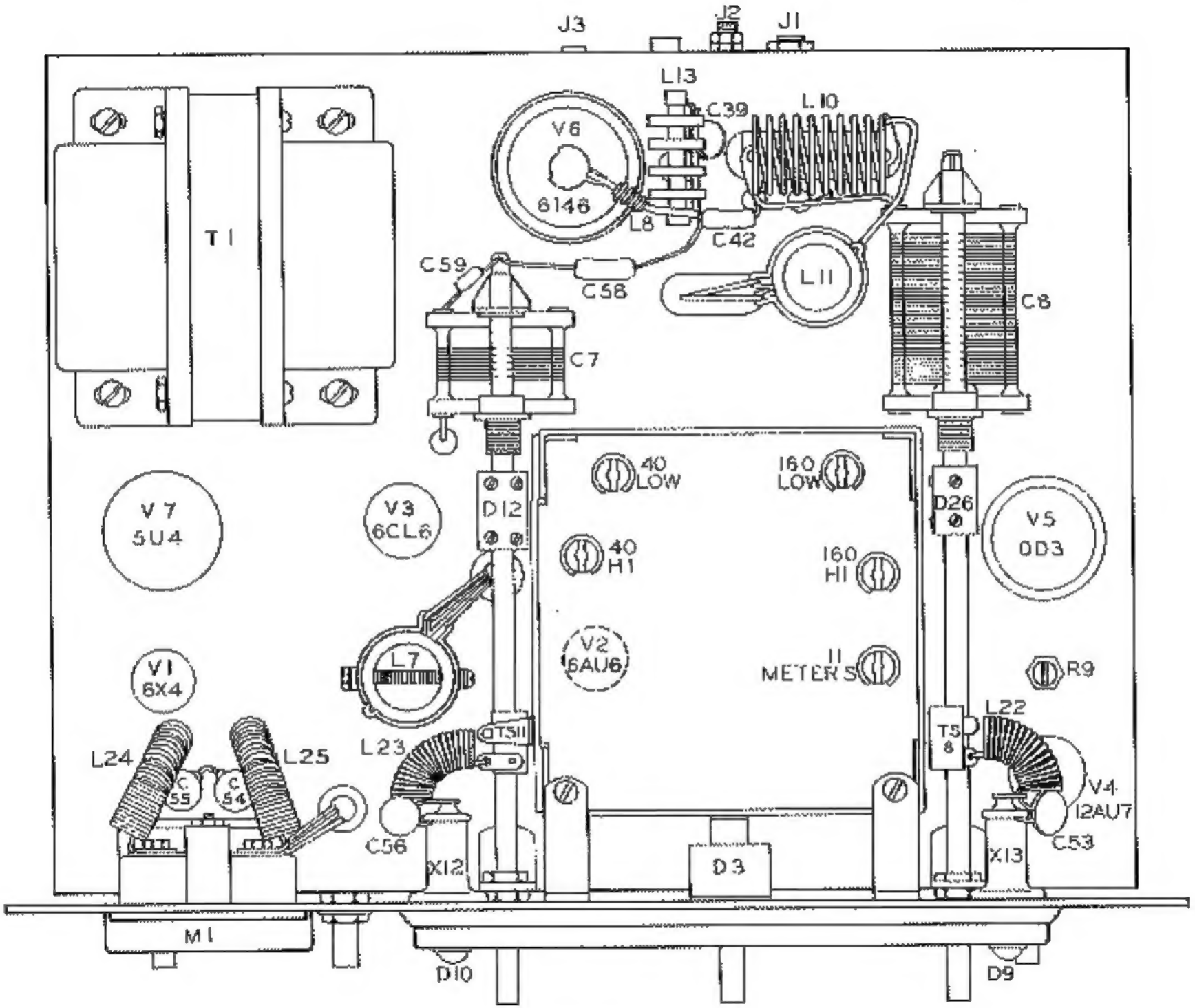

J3
J2
J1
L13
C39
L10
V6
6146
L8
C42
T1
C59
C58
L11
C8
C7
40
LOW
160
LOW
D26
V7
5U4
V3
6CL6
D12
V5
0D3
40
H1
160
H1
V2
6AU6
II
METERS
R9
V1
6X4
L7
L22
T5
8
L24
L25
L23
T5II
C
55
C
54
V4
12AU7
C56
X12
C53
X13
D3
M1
D10
D9

Figure 2

A. INTRODUCTION

1. Function

The Viking Navigator is a self contained VFO and exciter designed for amateur radio services. It may be used as an exciter or transmitter. It is rated at 40 watts input.

The ranges of operating frequency are:

1.75	to	2.0	mc.
3.5	to	4.0	mc.
7.0	to	7.42	mc.
14.0	to	14.85	mc.
21.0	to	21.6	mc.
26.9	to	27.36	mc.
28.0	to	29.7	mc.

2. Construction

The transmitter is 13 1/4" wide, 10 1/16" deep, 9 1/8" high, and weighs 22 pounds. A perforated aluminum cabinet and aluminum panel result in total enclosure with adequate ventilation.

All operating controls are located on the front panel, as well as the meter, dial and pilot lamps. Key jack, relay jack and output jack are located on the rear of the chassis.

To aid in eliminating spurious radiation that might result in interference to other services such as television broadcasting, the transmitter cabinet serves as an effective shield. All external connections such as power cord, key jack, and relay jack are equipped with individual RF filters to maintain cabinet shielding integrity.

Operating frequency is determined by the bandswitch and high stability, temperature compensated, integral variable frequency oscillator, both controlled from the front panel. The oscillator is calibrated directly in output frequency and the illuminated dial provides calibration points in (10 kc) increments throughout the frequency range.

Socket J4, located behind a dummy knob cover on the front panel will accommodate two crystals for spot frequency operation.

3. Auxiliary Equipment

Key - Any hand key, "bug", or electronic key may be used for CW operation. The dc current through the key is negligible and a keying relay is not required.

Antenna coupler - Unbalanced resistive antenna loads from 40 to 500 ohms impedance may be matched by the pi-network output tuning system. Antennas are easily designed to fall within this impedance range and an antenna coupler is not required.

If it is required to work into two wire balanced antenna transmission line systems, or to work into highly reactive antenna systems such as may be encountered by using one antenna for a number of different frequency bands, an antenna coupler such as the 250-23 Johnson Matchbox should be used. Alternative

A. 3. solutions to antenna problems may be found in the ARRL Handbook in the chapter "Transmission Lines and Antennas".

Low pass filters - While the pi-network output circuit of the Navigator provides good harmonic suppression, there are many locations where harmonic output must be reduced to an absolute minimum to avoid interference with "fringe area" reception. In this case a low pass filter such as the 250-20 Johnson is a highly desirable accessory. Since the low pass filter is a fixed impedance device (52 ohms in the case of the 250-20) antenna impedance matching flexibility must be acheived by using an antenna coupler after the low pass filter if other than 52 ohm transmission lines are used.

4. Power Requirements

The Navigator is designed to operate from a 117 volt, 50/60 cps single phase line. Since the VFO and final amplifier screen voltages are regulated, the equipment is substantially independent of line voltage regulation. With 117 volts line voltage, the power consumption is 120 watts. Line voltage should be between 105 and 130 volts.

B. DESCRIPTION

1. Exciter

The Navigator exciter section consists of a 6AU6 (V2) variable frequency oscillator and a 6CL6 (V3) crystal oscillator/multiplier. The primary method used to establish frequency control is the 6AU6 high stability electron coupled oscillator. The oscillator is voltage regulated and temperature compensated. Drift and frequency variation are negligible. The construction of these circuits is extremely rigid to minimize the effects of shock or vibration. Th 6AU6 oscillator is housed in a separate compartment, carefully shielded and isolated from all radio frequency circuits to avoid frequency modulation of the oscillator output. The oscillator is equipped with two separate tank circuits, one covering the range 1.75 to 2 mc., for output on the bands 1.75 to 2 mc., and 3.5 to 4.0 mc. The other tank circuit covers basically the range 7.0 to 7.4 mc. for all the other output frequencies except for 11 meter band. Here the oscillator tunes the range 6.725 to 6.84 mc., for output in the range 26.9 to 27.35 mcs. Oscillator tank circuits are selected by SW1 actuated from the shaft of bandswitch SW3 by the drive arm D1 and the cam D2. Oscillator frequency is determined by the capacitor C1A-B driven by the main dial and the planetary drive assembly D3.

Using the VFO frequency control, the 6CL6 crystal oscillator/multiplier serves as a frequency multiplier with a High Q plate circuit operating on the same frequency as the final amplifier on all bands. The plate circuit is switched by SW3A, and the plate circuit is tuned by C7, the dial marked Exciter. The screen voltage is varied by the switch SW3B and fixed resistors to maintain proper grid drive to the final amplifier.

With SW2 in the "C1" or "C2" position, the VFO is disabled by opening the cathode circuit of V2, the 6AU6. At the same time, one of the crystals is connected by SW2B between the grid of V3, 6CL6, and ground. The key is switched to the cathode of V3 and the transmitter is cathode keyed. The keying wave shape is controlled by R2, R26 and C57. In the C1 position of SW2B a crystal connected between pins 3 and 5 of J4 is operative. In the C2 position the crystal connected between 1 and 7 is in use.

B. 1. With SW2 in the VFO position, the cathode of V2, 6AU6, is grounded and the plate of V2 is connected to the grid of V3 through the coupling capacitor C41 and the crystals are removed from the circuit. At the same time, switch SW2A grounds the cathode of V3 and connects the key to the keyer tube to start the VFO.

To avoid chirp when the VFO is keyed, the keyer tube, V4, 12AU7 allows the VFO to start quickly - before V3 starts conducting and then continues operating until after V3 has stopped conducting. The wave shaping is controlled by R24, R3 and C49. If softer keying is desirable add capacity to C49, the .1 mfd. capacitor.

2. RF Amplifier

The final stage employs a 6146 tube, V6. Layout and design is such as to provide high efficiency together with stability and freedom from spurious output. The high Q output circuit has good efficiency throughout the operating range and provides excellent harmonic suppression when operated into non-reactive loads of 40 to 500 ohms impedance. The range of antenna impedance which may be matched at frequencies above 7 mc., extends, roughly, from 25 to 2000 ohms.

The inductance of the plate circuits of the amplifier is switched to change bands by means of the rear deck of SW3C. The amplifier is tuned to resonance by C8 operated from the front panel by the dial marked Final. The output coupling is adjusted by a coaxial switch and capacitor knob, marked Aux. coupling and Fine coupling. The screen of the 6146 is regulated to protect the tube when no excitation is applied. Bridge neutralization is employed to provide high stability over the entire frequency range.

3. Power Supplies

Two supplies are used to power the Navigator - the high voltage plate supply, nominally 360 volts in the transmit position, and the bias supply, nominally -150 volts when in the transmit position.

All supplies and filaments are energized by the operate switch, SW4. All supplies are protected by 1 1/2 amp. fuses in the line cord plug, P3.

The screen of the 6AU6 (V2) VFO and 6146 (V6) final amplifier are regulated by V5, a VR-150 voltage regulator. Normal use of J3, the antenna relay jack, is to provide 117 volts AC for an antenna change over relay. It has power applied when the operate switch is in Transmit position.

4. Panel Nomenclature and Control Functions

OPERATE switch SW4 - In the normally OFF position it removes line voltage from the transformer T1. In TUNE position it energizes T1, thereby supplying filament and plate voltage. The key line is grounded so the exciter stages can be tuned. In STANDBY position, the key line is opened and screen voltage removed from the final. In TRANSMIT position, the screen voltage is applied to the final, the plate indicator light is turned on, and the key line is grounded.

METER switch SW5 - Connects the meter to the grid or plate of the final amplifier to indicate exciter tuning (maximum grid current) and loading of the final.

B. 4. EXCITER - C7, tunes plate circuit of V3, the crystal oscillator/multiplier.

VFO - Determines the VFO frequency.

FINAL - C8 tank tuning capacitor which resonates the output circuit of the final amplifier.

OSCILLATOR switch SW2 - Selects either of two crystals or VFO frequency control. (In the zero position, keys the exciter for use in zero beating against the receiver signal.)

CRYSTALS - Dummy knob conceals socket J4 accommodating 2 FT243 type crystal holders. Crystal C1 plugs into socket terminals 3 and 5, crystal C2 plugs into socket terminals 1 and 7.

BAND - Switches SW1 and SW3, thereby selecting VFO tank circuit and determining tuning range of exciter stage and final amplifier.

AUX. coupling - Switch SW6 adjusts the output coupling capacity of the final amplifier pi-network by selecting fixed mica capacitors.

FINE coupling - C9, variable air dielectric capacitor, a component of the pi-network output circuit. This capacitor together with fixed mica capacitors provides a continuously variable output loading range.

C. INSTALLATION

1. Unpacking (factory wired transmitters)

After removing the transmitter from its shipping container, inspect it thoroughly for any possible damage from shipping. Claims against the carrier delivering the equipment must be made with the carrier's agent at the point of delivery. DO NOT SHIP DAMAGED EQUIPMENT BACK TO THE MANUFACTURER UNTIL AUTHORIZED TO DO SO BY THE MANUFACTURER. NOTIFY THE SERVICE DIVISION THAT A CLAIM IS BEING MADE AGAINST THE CARRIER.

D. OPERATION

1. Grounding

Before attempting to tune the transmitter and load it either into a dummy load or an antenna, the chassis should be grounded. This is necessary, not only as a safety precaution, but to insure that the chassis be at zero RF potential for effective TVI suppression and for efficient antenna loading.

The ground connection should be made from the screw provided on the back of the chassis, using a heavy conductor wire (#16 or larger) to a good earth ground. This wire should be as short as possible and may be to a water pipe, a copper rod driven into the ground approximately 6 feet or similar earth connection. If the transmitter chassis becomes "hot" with RF under operating conditions, try different lengths of ground wire and/or different grounds until this is eliminated.

A rough check on the effectiveness of the transmitter ground may be made by touching the chassis while watching the amplifier plate current with the transmitter operating into an antenna. A change in the current upon touching

D. 1. the chassis is indicative of an ineffective ground. A neon bulb may under some conditions glow when touched to the chassis, thus indicating that the chassis is at high RF potential.

2. Tuning Procedure

The tuning of the Viking Navigator is the same for all bands. Refer to Table 3 for the approximate dial settings and VFO frequency for the various settings of the bandswitch. With the meter switch in the "grid" position, the operate switch in the tune position, tune Exciter for maximum grid current as indicated by the milliammeter. Do not operate with the grid current above 150 on the plate scale. Then with the meter in the plate position, turn the operate switch to transmit and tune the final for minimum plate current (plate current dip). Next the coupling should be increased in small increments, returning the amplifier to minimum plate current after each change of the coupling controls. The coupling should be increased to the point where the dipped plate current is 11: milliamperes. NOTE: Dipping the amplifier to minimum plate current must always be the last tuning adjustment. The coupling switch should be in position 5 on 10 and 11 meters.

The following adjustments are primarily for kit builders, however, they can be useful in trouble shooting.

3. VFO Calibration

A. Definitions and General Information

The following instructions are for calibrating the Viking Navigator VFO using a signal generator for the frequency Standard and a receiver capable of tuning the calibration frequencies.

The accuracy of the Navigator VFO calibration will be no better than that of the signal generator used to calibrate it. To fully utilize the stability and calibration capabilities of the VFO, the frequency standard used to calibrate it should have an accuracy of .005% or better. Most crystal standards or crystal calibrated variable frequency standards are satisfactory for normal calibration purposes. A moderate signal output is required, capable of being easily detected with the receiver to be used for zero beat indication.

The frequencies F1a, F2a, F3a and F4a used in the text following are indicated output frequencies of the calibrating standard. The abbreviations F1, F2, F3 and F4 are VFO dial settings corresponding to frequencies F1a, F2a, F3a and F4a respectively. (F1a, F2a, F3a and F4a may be either fundamental frequencies or any harmonic it is desired to use.)

1. F1a Any given frequency (preferably a frequency corresponding to a low frequency VFO dial calibration mark) between 1.75 and 1.78 mcs. or any of the first eight harmonics of 1.75 to 1.78 mcs. on the range of the receiver. 1.76, 3.52, 5.28, 7.04, and 8.80 mcs. are good calibrating frequencies.

F2a Any given frequency (preferably a frequency corresponding to a high frequency VFO dial cal_ ration mark) between 1.96 and 2.00 mcs. or any of the first eight harmonics of 1.96 to 2.00 mcs. in the range of the receiver. 1.97, 3.94, 5.91, 7.88 and 9.85 mcs. are good calibrating frequencies.

D. 3. F3a Any given frequency (preferably a frequency corresponding to a low frequency VFO dial calibration mark) between 7.00 and 7.07 mcs. or any of the first four harmonics of 7.00 to 7.07 mcs. in the range of the receiver. 7.03, 14.06, 21.09 and 28.12 are good calibrating frequencies.

F4a Any given frequency (preferably a frequency corresponding to a high frequency VFO dial calibration mark) between 7.35 and 7.425 mcs. or the first four harmonics of 7.35 to 7.425 mcs. 7.40, 14.800, 22.2 and 29.6 mcs. are good calibrating frequencies.

Warm up the signal generator for at least half an hour or as long as suggested by the signal generator instructions before using it for VFO calibration.

Set up a receiver capable of detecting each of the frequencies selected. Attach antenna leads to the receiver input and the signal generator output. (Three or four foot lengths will probably be ample.) Bring the leads closer together until signal generator output can be picked up by the receiver. Separate and shorten the leads as found necessary to keep the receiver from blocking due to excessive signal input. Allow the receiver to warm up for about 1/2 hour to stabilize the local oscillator and log dial settings for frequencies F1a, F2a, F3a and F4a. The beat frequency oscillator in the receiver may be used to log and compare the signal generator and VFO frequencies but it is desirable to obtain the final zero beat indications between VFO and signal generator signals without the beat frequency oscillator. Avoid setting the receiver on or logging image frequencies.

Warm up the Viking Navigator in the TUNE position of the OPERATE switch for 1/2 hour. Turn the bandswitch to the 160 or 80 position. Turn the VFO dial pointer to the frequency F1, between 1.75 and 1.78 mcs. chosen for the low 160 meter calibrating point and find it or its harmonic (near F1a) on the receiver. Repeat the same procedure at the high 160 meter calibrating point and the 40 meter high and low points after moving the bandswitch to the 40 meter position.

2. 160, 80 Meter Scale Calibration

Set the Navigator bandswitch on the 160 or 80 meter position and the dial at F2, the dial reading corresponding to the frequency between 1.96 and 2.00 mcs. chosen for the high 160 meter calibrating point. Set the signal generator to F2a and tune in the signal on the receiver. Adjust the "160 hi" trimmer on top of the VFO (Figure 1) until the VFO zero beats with the signal generator.

Turn the signal generator to F1a, tune the receiver to the same frequency, turn the VFO to F1 and adjust the "160 lo" padder atop the VFO until the VFO zero beats with the signal generator.

Repeat the "160 hi" and "160 lo" adjustments, zero beating the signal generator and VFO as accurately as possible. Since the adjustments affect each other, several repeats of the adjustments may be necessary before attaining the most accurate setting possible.

3. 40, 20, 15, 10 Meter Scale Calibration

Set the Navigator bandswitch on the 40 or 20 meter position and the dial pointer at F4 on the high frequency dial scale, the frequency between 7.35 and

F. 3. 7.425 mcs. chosen for the high 40 meter calibration. Set the signal generator and the receiver at F4a. Adjust the "40 hi" trimmer at the top of the VFO until the VFO zero beats with the signal generator.

Turn the VFO to F3, the setting corresponding with the frequency between 7.00 and 7.07 mcs. chosen for the low 40 meter calibration, the receiver to F3a, the signal generator to F3a and adjust the "40 lo" padder until the VFO zero beats with the signal generator.

Repeat the "40 hi" and "40 lo" adjustments, zero beating the signal generator and VFO as accurately as possible.

4. 11 Meter Calibration

The 11 meter band VFO output is near 6.75 mcs. A given frequency, F5a, in the range 6.7 to 6.85 mcs. or any of the first four harmonics of the 6.7 to 6.85 mcs. range may be used to calibrate the 11 meter range. Turn the Navigator bandswitch to the 11 meter band, set the VFO dial to the position F5 corresponding to the frequency F5a or its harmonic which falls in the 11 meter band. Set the receiver to the 11 meter range or a subharmonic and detect the standard signal frequency. Adjust the "11 meter" trimmer until the VFO zero beats with the standard frequency.

Recheck the 40 or 20 meter calibration after the 11 meter adjustment. There is little likelihood that further readjustments are necessary unless a large change was required in the "11 meter" setting.

5. Calibration Against Crystals

Crystals of known frequency and accuracy in the frequency ranges F1a, F2a, F3a and F4a (designated in section F1) may be used in the transmitter crystal oscillator to provide standard frequency signals for the VFO calibration. The stability of the receiver local oscillator and beat frequency oscillator must be nominally good as the technique of beating the receiver BFO to the crystal and then beating the VFO signal to the receiver will be used. The receiver thus "remembers" the crystal frequency. Reduce the coupling of the receiver antenna to the minimum usable amount to avoid "pulling" of the local oscillator.

An example of calibrating the VFO using actual crystal values may be helpful. Assume that the following crystals have been found as part of the amateur station equipment: 7060 kcs., 3690 kcs. and 1980 kcs. The dial calibration points then become:

$$F1 = \frac{7.060}{4} = 1.765 \text{ mcs.}$$

$$F2 = 1.980 \times 1 = 1.980 \text{ mcs.}$$

$$F3 = 7.060 \times 1 = 7.060 \text{ mcs.}$$

$$F4 = 3.690 \times 2 = 7.380 \text{ mcs.}$$

The receiver setting and VFO harmonic which may be used for each respective dial calibration frequency then becomes:

$$F1a = 7.060 \times 1 = 7.060 \text{ mcs.}$$

$$F2a = 1.980 \times 4 = 7.920 \text{ mcs.}$$

$$F3a = 7.060 \times 1 = 7.060 \text{ mcs.}$$

$$F4a = 3.690 \times 2 = 7.380 \text{ mcs.}$$

F. 3. Proceed as follows:

(1) Place the 1.980 mc. crystal in the C1 position of J4 (pins 3 and 5) and the 7.070 mc. crystal in the C2 position (pins 1 and 7 of J7).

(2) Set the bandswitch on 160 or 80 meters, the VFO dial pointer on the 1.980 mc. mark, the OSCILLATOR switch on C1 position. Tune the receiver to zero beat the BFO with the crystal. Turn the OSCILLATOR switch to the VFO position and adjust the "160 hi" trimmer to zero beat the receiver BFO.

(3) Set the VFO pointer on the 1.765 mc. mark, and the OSCILLATOR switch to the 7.060 mc. position (C2). Tune the receiver to zero beat the BFO with the crystal. Turn the OSCILLATOR switch to VFO and adjust the "160 lo" padder to zero beat the BFO. Repeat steps 2 and 3 as necessary to cancel out interaction between the "160 lo" and "160 hi" adjustments.

(4) Remove the 1.980 mc. crystal from the C1 position and replace it with the 3.690 mc. crystal.

(5) Set the bandswitch on 40 meters, the VFO dial pointer to 7.380 mcs. and the OSCILLATOR switch to C1. Tune the receiver to zero beat the BFO with the crystal. Turn the OSCILLATOR switch to VFO and adjust the "40 hi" trimmer to zero beat the BFO.

(6) Set the VFO pointer on 7.060 mcs. and the OSCILLATOR switch to C2. Tune the receiver to zero beat the BFO with the crystal. Turn the OSCILLATOR switch to VFO and adjust the "40 lo" padder to zero beat the BFO. Repeat steps 5 and 6 to minimize adjustment reaction.

(7) The 11 meter band setting may be made with a crystal which will place a harmonic signal in the 11 meter band. Set the bandswitch on 11 meters, the OSCILLATOR switch to the crystal (assume 1.810 mcs. is available) position. Zero beat the receiver BFO to 27.150 mcs. (the 15th harmonic of 1.810 mcs.). Turn the OSCILLATOR switch to VFO and adjust the "11 M" trimmer to zero beat the VFO to the receiver BFO.

(8) Recheck the "40 hi" and "40 lo" adjustments, steps 5 and 6.

The user may think of several sources of standard signals other than those mentioned. In each case, the accuracy of the source should be known before using it. Many combinations of harmonics can be found and no attempt has been made to cover all of them in this discussion. Other signal sources which may be used but are not covered here are:

(a) The signal of another amateur station whose frequency has been determined by a standard.

(b) The harmonics of a signal generator the output signal of which has been zero beat with a broadcast station.

(c) Signals of WWV discussed in the next topic.

The user must adapt his techniques to the signal source he has available.

Band edge crystals or crystals near the usual operating frequencies of the amateur stations are always valuable for occasional monitoring of the VFO signals. They may be used in a separate oscillator circuit or the crystal

F. 3. oscillator stage of the transmitter.

6. Calibration Against WWV

The following technique for calibration against the WWV 10 mc. signal is not recommended if other standard signal sources are available. It will be noted that most calibration points are on the ends of the bands. The receiver, the receiver BFO and the VFO should be warmed up 1/2 hour before calibrating.

(1) Zero beat the receiver BFO with the 10 mc. WWV signal.

(2) Set the VFO dial pointer to 2.00 mcs., the bandswitch on 160 meters.

(3) Adjust the "160 hi" VFO trimmer until the fifth harmonic of the VFO is zero beat with the receiver BFO.

(4) Leaving the VFO at this setting, zero beat the receiver BFO with the seventh harmonic of the VFO (14 mcs.).

(5) Turn the VFO to 1.75 mcs. and adjust the "160 lo" VFO padder to zero beat the eighth harmonic of the VFO with the receiver BFO.

(6) Adjust both ends of the 160 meter band to zero beat the eighth and seventh harmonics of the VFO with the receiver BFO as necessary to cancel adjustment interaction.

40, 20, 15 and 10 meter calibration

(7) Set the VFO dial at the 1.85 mc. mark and zero beat the receiver BFO to the eighth harmonic of the VFO frequency at 14.8 mcs.

(8) Set the bandswitch to 40 meters and dial pointer to the 7.40, 29.6 mc. mark. Zero beat the second harmonic of the VFO to the 14.8 mcs. receiver setting by adjusting the "40 hi" trimmer.

(9) Set the bandswitch and dial pointer for 1.75 mc. VFO output again and zero beat the receiver BFO at 14 mcs. Set the bandswitch and dial for 7.0 mc. VFO output. Adjust the "40 lo" padder to zero beat the VFO second harmonic with the receiver 14.0 mc. BFO setting.

11 meter calibration

(10) Set the bandswitch and VFO dial for 1.80 mc. output.

(11) Tune the receiver to 27 mcs. and zero beat the receiver BFO to the fifteenth harmonic of the VFO.

(12) Set the bandswitch on 11 and the dial pointer on 27.0 mcs. Adjust the "11 meter trimmer to zero beat the fourth harmonic of the VFO to the receiver BFO setting.

7. Calibration Trouble Shooting

If the VFO frequency cannot be adjusted to the dial markings due to apparent lack of trimmer or padder range.

Check to make certain the frequency standard used is accurate (crystals

F. 3. used in amateur service are often found to differ from their marked frequency due to holder conditions, oscillator circuit loading or non-critical original calibration).

Make certain image frequencies are not being mistaken for desired frequencies in the receiver.

If, after checking the frequency standard and receiver settings, the VFO frequency cannot be adjusted to chosen dial marks, adjust the trimmers to bring the VFO as close as possible to correct calibration. Remove the VFO side cover and recheck the dial location relative to the tuning capacitor shaft. The VFO tuning capacitor should be exactly meshed (not necessarily the stop position) when the dial pointer precisely horizontal to the left. If the dial requires re-positioning, loosen the two set screws in the shaft coupler attached to C1 from beneath the chassis, re-set the dial, tighten both set screws. This should permit the VFO to be calibrated properly.

To obtain proper adjustment of L12, the variable VFO output inductor, the following procedure must be used:

With the bandswitch on 10 meters and the VFO dial set to 29 mc., tune the exciter for maximum indication in grid position. This is done with the operate switch in tune position. The adjustable slug is reached through the hole in the buffer shield, under the chassis. It is peaked for maximum grid indication.

4. Keyer Adjustment

The keyer control R9 is a potentiometer with slotted shaft located between the keyer, V4, and Vr, V5, tubes. Plug a key into the key jack J1. Set the Bandswitch and VFO to any convenient receiving frequency. With the transmitter in the Standby position, close the key and tune the exciter dial for maximum grid drive. Tune the receiver to the VFO frequency. Open the key and rotate R9 to the full clockwise position. This will key the VFO. Now turn R9 slowly counter-clockwise until the VFO drops out of oscillation. Do not leave the keyer adjustment at exactly the point where the VFO drops out of oscillation. Turn R9 slighly counter-clockwise beyond this point,otherwise VFO instability can result.

5. Trouble Shooting

Operational problems may be due either to tube failure, component failure or improper operational technique.

Frequently, malfunction of a piece of equipment such as the Navigator is the result of a tube failure. Meter readings will usually indicate the probable stage affected and servicing requires only substitution of known good tubes. In any case, the tubes should be tested first and eliminated as the source of trouble.

To service the equipment, make liberal use of current values, normal voltage readings and resistance measurements appearing in this manual.

Look first for the simple faults but remember that a component failure often produces a second collateral component failure and to restore normal operation both must be remedied.

TABLE 1

VIKING NAVIGATOR VOLTAGE MEASUREMENTS

Line Voltage 117 V.A.C.
RF Load 50 Ohms
Final Plate 115 MA
RF Output Freq. 7 mcs.
Measured with a 20K ohms/V. Meter from chassis
Voltage Tolerance, plus or minus 20%

TUBE	TUNE	TRANSMIT	KEY UP
6146 V6			
Pin 3 screen	0	150 V.D.C.	150 V.D.C.
Pin 5 grid (Read at Term. 2 of TS2)	-85	-70	-65
Pin 5 plate (Read on Term. 3 of TS10)	400	340	405
5U4GB V7			
Pin 2	410	370	415
Pin 3	405	350	405
6X4 V1			
Pin 1	-145	-140	-150
6CL6 V3			
Pin 3 screen	150	130	200
Pin 6 plate	400	380	410
Pin 9 grid	-2.3	-3.8	-105
Pin 1 cathode	0	0	0
12AU7 V4			
Pin 1 plate	-.7	-.65	-43
Pin 2 grid	-34	-32	-75
Pin 3 cathode	+17	+15	-80
Pin 6 plate	400	340	410
Pin 7 grid	0	0	-105
Pin 8 cathode	+17	+15	-75

TABLE 2

VIKING NAVIGATOR RESISTANCE MEASUREMENTS

Operate Switch - Off
Bandswitch - 40 Meters
Oscillator Switch - VFO

TUBE	RESISTANCE TO CHASSIS
6146	
Pin 3	Infinite
Pin 5	9K ohms
Plate	52K ohms
6CL6	
Pin 3	25K ohms
Pin 6	50K ohms
Pin 9	120K
Pin 1	0

TUBE	RESISTANCE TO CHASSIS
5Y4GB	
Pin 2	52K ohms
Pin 3	52K ohms
12AU7	
Pin 1	22K ohms
Pin 2	1.1 megohm
Pin 3	37K ohms
Pin 6	50K ohms
Pin 8	32K ohms

TABLE 3

VIKING NAVIGATOR TRANSFORMER AND CHOKE MEASUREMENTS

T1 - 22.1407 SNC #P3302

LEADS	OPEN CIRCUIT	RESISTANCE (OHMS)
Red to Red Yellow	500 V.A.C.	130 ohms
Red to Red Yellow	500 V.A.C.	130 ohms
Blue to Red Yellow	205 V.A.C.	55 ohms
Green to Green	7 V.A.C.	.1 ohms
Yellow to Yellow	5.5 V.A.C.	.05 ohms
Black to Black		1.75 ohms

L16 - 22.1213 SNC #P3025

Black to Black	190 ohms

TABLE 4

VIKING NAVIGATOR TYPICAL DIAL SETTINGS

50 Ohm Resistive Load

Oscillator - VFO

Final Plate - 115 MA.

FREQ. MC.	EXCITER	FINAL	COURSE-COUPLING	FINE
1.75	33	38	2	0
2	72	89	3	0
3.5	32	40	3	1
4.0	70	78	3	8
7.0	48	50	4	9
7.4	62	55	5	1
14	46	68	5	4
14.8	60	72	5	4.5
21	65	82	5	6
21.6	71	85	5	6
28	65	72	5	7
29.7	78	78	5	7
26.9	56	74	5	6
27.35	60	76	5	6

VIKING NAVIGATOR TRANSMITTER

Parts List

Part No. or Drawing No.	Item No.	Qty.	Description
16.1001-4	BKT1,2	2	Topchassis component mounting brackets
16.1001-1	BKT3	1	Underchassis component mounting bracket
16.1165-1	BKT4	1	Underchassis bandswitch bracket
16.1167-2	BKT8-11	4	VFO condenser brackets
16.1338	BKT12	1	Meter switch bracket
16.82-24	BKT13,14	2	L bracket VFO stiffener
169-26	C1A,B	1	Special LA dual variable capacitor
160-107-51	C2,5	2	15M11 variable capacitor
160-107-50	C4	1	15M11 variable capacitor
160-130-50	C3,6	2	30M8 variable capacitor
149-3-5	C7	1	50R12 variable capacitor
149-10	C8	1	250R12 variable capacitor
22.1102-2	C9	1	700 mfd variable capacitor
22.1014	C10	1	47 mmf 2 1/2% N150 500 V. ceramic capacitor
22.954	C11	1	62 mmf 2 1/2% NPO 500 V. ceramic capacitor
22.804	C12,13,50	3	500 mmf 2% 500 V. silver mica capacitor
22.805	C14,15,29	3	1000 mmf 2% 500 V. silver mica capacitor
22.809	C16	1	91 mmf 2 1/2% N080 ceramic capacitor
22.823	C17	1	140 mmf 2 1/2% NPO 500 V. ceramic capacitor
22.807	C18	1	43 mmf 2 1/2% NPO 500 V. ceramic capacitor
22.827	C19-28,30-35, 52-56	21	.005 mfd 600 V. GMV ceramic capacitor
22.777	C36	1	25 mmf. 500 V. 5% silver mica capacitor
22.776	C37	1	50 mmf. 500 V. 5% silver mica capacitor
22.1297	C38	1	330 mmf. 500 V. 5% silver mica capacitor
22.828	C39	1	.001 mfd 1.5 KV ceramic capacitor
22.862	C40,51	2	200 mmf 500 V. 20% mica capacitor
22.859	C41	1	300 mmf 500 V. 5% silver mica capacitor
22.955	C42	1	.002 mfd 20% 1.5 KV molded mica capacitor
22.4269-10	C43-46	4	680 mmf 500 V. 10% silver mica capacitor
22.962	C47,48	2	30 mfd at 450 V. electrolytic capacitor
22.768	C49	1	.1 mfd 400 V. paper capacitor
22.1409	C57	1	.5 mfd 200 V CD Pup-MP2P5 capacitor
22.1410	C58	1	6.8 mmfd. 1500 V. mica capacitor
22.1185-2	C59	1	10 mmf $\pm$ 5% 500 V. Durmica capacitor
17.1059	CH1	1	Chassis
23.1281-2	CH2	1	Cabinet
17.1057-3	CH3	1	Front panel
17.820	CH4	1	VFO top
17.819	CH5	1	VFO side plate
18.699	CH6	1	VFO phenolic plate
17.855	CH7	1	VFO sub-chassis
22.928-1	CH9	4	Bumper feet

Parts List

Part No. or Drawing No.	Item No.	Qty.	Description
23.1059	D1	1	Drive arm for VFO switch
14.504	D2	1	Drive cam for VFO switch
23.1062	D3	1	Planetary drive assembly
17.858-3	D4	1	Dial escutcheon
22.993-2	D5	1	Dial plate
22.994	D6	26"	Rubber gasket
22.995	D7	5"	Rubber light blocks
23.1064	D8	1	Dial pointer
23.564-56	D9	1	Red jewel
23.564-57	D10	1	Green jewel
13.123-12	D11	4	3/8" 32 panel bearings
18.666-4	D12	1	Insulated coupling (less set screws)
13.155-4	D13	2	VFO sub-chassis spacers
14.31-62	D14	2	1 3/8" crystal socket spacers
14.31-64	D15	4	2 1/8" VFO chassis rods
14.31-65	D16	4	2 15/16" VFO chassis rods
14.139-1	D17	2	5 5/16" extension shafts
18.638-2	D18	5	VFO trimmer shafts
23.907-22	D19	2	100-0 knobs
23.1245	D20	2	Phenolic knobs 1 1/8"
23.1060	D21	1	Crystal knob cover
104-264-3	D22	2	Insulated shaft coupler (flexible)
13.123-15	D23	1	9/32"-3/8 panel bearing
32.46-13	D24	1	2 3/8" maroon knob
23.1246	D25	1	1 5/8" band knob
13.760-2	D26	1	Metal coupler
23.1248	D27	1	Phenolic outer knob 1 1/8
13.889-1	D28	1	Aluminum center knob
16.35-1	E1	1	Tube cap
22.1397	F1,2	2	1.6 amp. fuse
22.113-1	G1-4	4	9/16" O.D. grommets
22.113-5	G5-7	3	11/32" O.D. grommets
23.1282	H1	1	Harness
29.116-3	HW	28	#4 NP internal tooth lockwashers
29.69-3	HW	94	#6 internal tooth lockwashers
29.00-2	HW	2	#8 internal tooth lockwashers
29.15-1	HW	7	#10 internal tooth lockwashers
29.65-3	HW	10	3/8 internal tooth lockwashers
29.394-3	HW	1	3/4 I.D. internal tooth lockwasher
22.377	I1-4	4	#51 pilot lamps
22.1246	J1	1	Single closed circuit jack
22.1096	J2	1	Coaxial output jack
126-105	J3	1	Relay jack
22.849-2	J4	1	Octal socket

Parts List

Part No. or Drawing No.	Item No.	Qty.	Description
23.968-2	L1	1	Dual VFO coil
22.1193	L2-4,15	4	2.4 MH RF choke
22.844-1	L5,18	2	200 UH RF choke (coded red)
22.844-3	L6	1	100 UH RF choke (coded black)
23.902-13	L7	1	Buffer coil
23.912-5	L8	1	Plate parasitic suppressor
23.913-2	L9	1	H.F. buffer coil
23.913-3	L10	1	H.F. final tank
23.1283	L11	1	Final tank coil
23.1204-2	L12	1	VFO output coil, variable
22.951	L13	1	2.5 MH RF choke
22.844-2	L14	1	52 UH RF choke (coded green)
22.1213	L16	1	10 henry choke
23.1000	L17	1	4.7 UH RF choke
22.1403	M1	1	Meter
22.1095	P1	1	Single phono plug
23.1031	P2	1	Relay plug
22.981	P3	1	Fused power plug
22.1115	R9	1	100K ½ watt linear potentiometer
22.5097-10	R1-3,26	4	100K ½ watt carbon resistor 10%
22.5019-10	R4	1	56 ohm ½ watt carbon resistor 10%
22.7079-10	R6	1	18K 2 watt carbon resistor 10%
22.5041-10	R7	1	470 ohm ½ watt carbon resistor 10%
22.5121-10	R8	1	1 meg. ½ watt carbon resistor 10%
22.5105-10	R10	1	220K ½ watt carbon resistor 10%
22.5081-10	R24,25	2	22K ½ watt carbon resistor 10%
22.6073-10	R13	1	10K 1 watt carbon resistor 10%
22.7065-10	R14	1	4700 ohm 2 watt carbon resistor 10%
22.5061-10	R15,16	2	3300 ohm ½ watt carbon resistor 10%
22.6081-10	R27	1	22K 1 watt carbon resistor 10%
22.7081-10	R17	1	22K 2 watt carbon resistor 10%
22.6069-10	R18,20	2	6800 ohm 1 watt carbon resistor 10%
22.8902-10	R21	1	8200 ohm 10% PW10 10 watt IRC resistor
22.6013-5	R23	1	33 ohm 5% 1 watt carbon resistor
22.6077-10	R22	1	15K 1 watt carbon resistor 10%
17.846	SH2	1	VFO shield
17.857-2	SH3	1	Buffer shield
22.988	SW1	1	VFO bandswitch
22.1408	SW2	1	VFO crystal switch
22.1404	SW3	1	Bandswitch
22.1405	SW4	1	Operate switch
22.1415	SW5	1	Meter switch
22.1406	SW6	1	Output coupling switch

VIKING NAVIGATOR TRANSMITTER

Parts List

Part No. or Drawing No.	Item No.	Qty.	Description
22.1407	T1	1	Power transformer
22.740-8	TS1	1	8 lug terminal strip
22.740-7	TS2,3	2	7 lug terminal strip
22.740-5	TS4	1	5 lug terminal strip
22.740-3	TS5-7	3	3 lug terminal strip (2 mounting holes)
22.837	TS8,9,11,14	4	2 lug terminal strip
22.740-2	TS13	1	2 lug terminal strip (2 mounting holes)
22.1401-1	TS10,12	2	3 lug terminal strip (1 mounting hole)
22.1366	V1	1	6X4 electron tube
22.780	V2	1	6AU6 electron tube
22.1118	V3	1	6CL6 electron tube
22.916	V4	1	12AU7 electron tube
22.1109	V5	1	VR-150/0D3 electron tube
22.788	V6	1	6146 electron tube
22.1104	V7	1	5U4 GA electron tube
71.91-100	W1	6½ ft.	#20 black plastic covered tinned copper wire
71.91-102	W2	5½ ft.	#20 red plastic covered tinned copper wire
71.91-103	W3	1½ ft.	#20 orange plastic covered tinned copper wire
71.91-104	W4	2 5/6 ft.	#20 yellow plastic covered tinned copper wire
71.91-105	W5	3½ ft.	#20 green plastic covered tinned copper wire
71.91-106	W6	1 5/6 ft.	#20 blue plastic covered tinned copper wire
71.27-115	W13	4 1/3 ft.	#16 bare tinned copper wire
71.49-114	W8	7 ft.	Black line cord 18-2 POSJ type
22.997	W9	½ ft.	3/8 round wood dowel
42.24-050	W10	5/6 ft.	.053 I.D. varnished tubing
71.13-125	W11	19 ft.	#18 formex or Nylclad copper wire
42.49-140	W12	3 ft.	#4 waxed cord for tieing wire cable
71.91-109	W7	½ ft.	#20 white plastic covered tinned copper wire
23.1047	XI2,3	2	Lamp socket assembly
23.566-3	XI1,4	2	Lamp socket bayonet
22.975	XV1,2	2	7 pin miniature mica filled socket
22.976	XV3,4	2	9 pin miniature mica filled socket
22.1274	XV5-7	3	8 pin octal mica filled socket

JOHNSON VIKING NAVIGATOR EXCITER

Model 240-126-1 (Kit Form) Serial 85589
240-126-2 (Assembled and Tested)

OPERATING MANUAL CONTENTS

TABLES

ILLUSTRATIONS

12/10/57

STANDARD WARRANTY

Adopted and Recommended by the

Radio - Electronics - Television Manufacturers Association

The E. F. Johnson Company warrants each new radio product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part, except for electron tubes, in exchange for any part of any unit of its manufacture which under normal installation, use and service disclosed such defect, provided the unit is delivered by the owner to us or to our authorized radio dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within ninety days from the date of sale to original purchaser and provided that such examination disclosed, in our judgment, that it is thus defective.

This warranty does not extend to any of our radio products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been repaired or altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture, nor to electron tubes.

Defective electron tubes should be returned directly to the tube manufacturer for adjustment at the following addresses:

(a) For RCA tubes to: Adjustment Service, RCA at the nearest of the following addresses:

34 Exchange Place Jersey City 2, New Jersey	3601 South Adams Street Marion, Indiana	6355 East Washington Blvd Los Angeles 22, Californ...

(b) For General Electric tubes to:

Adjustment Service
Owensboro Tube Works
General Electric Company
Owensboro, Kentucky

Any part of a unit approved for remedy or exchange hereunder will be remedied or exchanged by the authorized radio dealer or wholesaler without charge to the owner.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio products.

W A R N I N G

The voltages encountered in this piece of equipment are high enough to cause fatal injury! Practice safety rules until they are second nature. Always turn off the high voltage before making any adjustment inside the transmitter. Never depend on a bleeder resistor to discharge filter capacitors. After the power is turned off, short circuit the high voltage circuit. Never operate the transmitter with any other than the recommended fuses in the primary circuit. The fuses will protect your equipment; in case of accidental contact with the high voltage, they may save your life. If children have access to the open transmitter, always disable the primary circuit by removing the f...s, or the high voltage circuits by removing the rectifiers. Always remove the line cord plug from the power source when working inside the transmitter.